

WHAT IS CLAIMED IS:

1. A powertrain system of a hybrid electric vehicle (HEV), comprising:
an engine;
a clutch;
5 a primary motor;
an automated shift gearbox (ASG) connected to the engine through the clutch;
a secondary motor; and
a differential gearbox,
wherein the primary motor is disposed between an output shaft of the clutch
10 and an input shaft of the ASG, and the secondary motor is disposed between an output
shaft of the ASG and an input shaft of the differential gearbox.

2. The powertrain system of claim 1, further comprising a controller executing a
shift operation by controlling the engine, the clutch, the primary and secondary motors,
15 and the ASG,
wherein the controller adjusts outputs of the engine and the primary and
secondary motors during the shift operation.

3. The powertrain system of claim 2, wherein the controller executes a clutch
20 disengagement mode during the shift operation, the clutch disengagement mode
comprising:
controlling an output torque of the engine during a disengagement of the clutch
such that the output torque of the engine lies within a predetermined torque capacity of
the clutch;
25 controlling a rotation speed of the engine after the disengagement of the clutch
such that the rotation speed of the engine is synchronized with a rotation speed of the
output shaft of the clutch at a target shift-speed; and
controlling the primary and secondary motor such that a required torque is
output through the input shaft of the differential gearbox.

4. The powertrain system of claim 3, wherein the controller executes a current
shift-speed release mode during the shift operation, the current shift-speed release mode

comprising:

disengaging a current shift-speed of the ASG after the disengagement of the clutch; and

controlling, when the current shift-speed is disengaged, a rotation speed of the input shaft of the ASG using the primary motor such that the rotation speed of the input shaft of the ASG is synchronized with one at the target shift-speed.

5. The powertrain system of claim 4, wherein the controller executes a target shift-speed engagement mode during the shift operation, the target shift-speed engagement mode comprising:

engaging the target shift-speed after the rotation speed of the input shaft of the ASG is synchronized with the one at the target shift-speed; and

controlling, after the engaging the target shift-speed, the primary and secondary motors such that the required torque is output through the input shaft of the differential gearbox.

6. The powertrain system of claim 5, wherein the controller executes a shift finishing mode during the shift operation, the shift finishing mode comprising engaging the clutch after the target shift-speed is engaged and the rotation speed of the engine is synchronized with the rotation speed of the output shaft of the clutch at a target shift-speed.

7. A powertrain system for a hybrid electric vehicle, comprising:

an internal combustion engine

a first clutch receiving power from said engine;

an automated shift gearbox receiving power from said clutch;

a first electric motor disposed in said powertrain between said clutch and said gearbox;

a differential receiving power from said gearbox; and

a second electric motor disposed in said powertrain between said gearbox and said differential.

8. The powertrain system of claim 7, further comprising a controller programmed with instructions for controlling said engine, clutch, motors and automated shift gearbox.

9. The powertrain system of claim 8, wherein said instructions comprise instructions for:

adjusting outputs of said engine and motors during a shift operation;
executing a clutch disengagement during said shift operation;
executing a current shift-speed release during said shift operation;
executing a target shift-speed engagement during said shift operation; and
executing a shift finish during said shift operation.

10. The powertrain system of claim 9, wherein said clutch disengagement instructions comprise:

controlling an output torque of the engine during disengagement of the clutch such that the output torque of the engine lies within a predetermined torque capacity of the clutch;

controlling rotation speed of the engine after disengagement of the clutch such that engine rotation speed is synchronized with clutch output rotation speed; and

controlling the primary and secondary motors such that a required torque is output to the differential.

11. The powertrain system of claim 9, wherein said shift release instructions comprise:

disengaging a current shift-speed of the automated shift gearbox after disengagement of the first clutch; and

controlling input to the automated shift gearbox using said primary motor when the current shift-speed is disengaged such that rotation speed of the input to the automated shift gearbox is synchronized with the target shift-speed.

12. The powertrain system of claim 11, wherein said target shift engage instructions comprise:

engaging the target shift-speed after the rotation speed of the input to the automated shift gearbox is synchronized at the target shift-speed; and
controlling the primary and secondary motors after engaging the target shift-speed such that required torque is output to the differential.

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13. The powertrain system of claim 12, wherein said shift finish instructions comprise engaging the first clutch after said target shift-speed is engaged and engine rotation speed is synchronized with said first clutch output speed.